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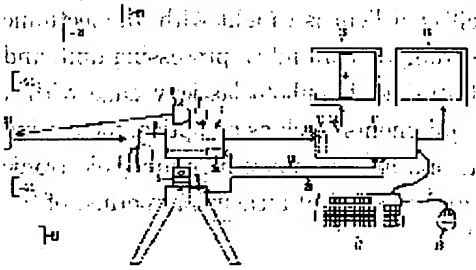
(54) OPTICAL MEASURING METHOD FOR STRESS

(57)Abstract:

PURPOSE: To dispense with the wiring between a sensor detecting the stress strain of a structure and a measuring instrument and automate measurement.

CONSTITUTION: Polarizing plates 3, 7 and 1/4 wavelength plates 4, 8 are fitted to an electronic camera 1 and a light source 6 respectively so that the light elastic effect of light elastic gauges 21, 21... stuck to the structure can be observed. The action of the electronic camera 1 is controlled by a computer 11. The RGB signals of the electronic camera 1 are stored in a frame memory 14, and the hue coordinates of the light elastic gauges 21, 21... on a screen are calculated by the computer 11. The strain quantity and stress are calculated via the displacement quantity of the light elastic gauges 21 from the hue coordinates of the reference color and stored in a memory device.



CLAIMS

[Claim(s)]

[Claim 1] The optical measuring method of the stress which sticks a photoelasticity gage on the front face of a stress measuring object object, irradiates the passage light of a polarizing plate to this photoelasticity gage, catches the reflected light with an electronic camera through a polarizing plate, inputs the RGB code of said electronic camera into a processing unit, converts the variation of said RGB code into the amount of strains of a photoelasticity gage with a processing unit, and calculates stress from said amount of strains.

[Claim 2] The optical measuring method of the stress according to claim 1 which carries out program control of the actuation of photography equipments, such as the above-mentioned electronic camera, and a processing unit with a control unit, and performs stress measurement automatically.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the stress measuring method which measures the stress strain of the structure optically about a stress measuring method.

[0002]

[Description of the Prior Art] Conventionally, the strain gage is used for measurement of a stress strain of the structure. This approach sticks a strain gage on the front face of the structure to measure, measures change of the electric resistance between the both-ends children of a strain gage, and converts it into the amount of strains.

[0003]

[Problem(s) to be Solved by the Invention] Since the stress measuring method by the strain gage mentioned above connects a measuring instrument and a strain gage with an electric wire, when a large number [point of measurement], the quantity of an electric wire also increases and wiring and management become complicated. Then, wiring is made unnecessary, the technical technical problem which should be solved in order to collect data automatically and to attain reduction and laborsaving of materials arises, and this invention aims at solving this technical problem.

[0004]

[Means for Solving the Problem] Propose this invention in order to attain the above-mentioned purpose, and it sticks a photoelasticity gage on the front face of a stress measuring object object. Irradiate the passage light of a polarizing plate to this photoelasticity gage, and the reflected light is caught with an electronic camera through a polarizing plate. Input the RGB code of said electronic camera into a processing unit, and the variation of said RGB code is converted into the amount of strains of a photoelasticity gage with a processing unit. Program control of the actuation of photography equipments, such as an optical measuring method of the stress which calculates stress from said amount of strains, and the above-mentioned electronic camera, and a processing unit is carried out with a control unit, and the optical measuring method of the stress which performs stress measurement automatically is offered.

[0005]

[Function] If the light which passed the polarizing plate to the photoelasticity gage is irradiated and the reflected light is observed with an electronic camera through a polarizing plate, the hue of a photoelasticity gage will change with the amounts of strains of a photoelasticity gage. Also with angle of rotation of a polarizing plate, a hue changes and can measure the amount of strains of a photoelasticity gage by getting to know the variation rate of polarization angle of rotation. The hue of the output signal of an electronic camera also changes with hue change of a photoelasticity gage, a processing unit calculates the amount of strains with an operation means to compute the amount of strains of a photoelasticity gage from the hue coordinate of an RGB code, and the stress of the part on which the photoelasticity gage was stuck is measured from the calculated amount of strains.

[0006] In addition to the operation which mentioned above invention according to claim 2, actuation of photography equipment and arithmetic units, such as an electronic camera and the light source, is controlled by the control unit, and measurement and data processing are automatically performed according to the set-up program.

[0007]

[Example] Hereafter, one example of this invention is explained according to drawing. In drawing 1 , 1 is electronic cameras, such as the so-called floppy camera for static-image photography, or a video camera, and can output a picture signal as an RGB code. An automatic focus device is built in, it is equipped with a polarizing plate 3 and the quarter-wave length plate 4 at the tip of a zoom lens 2, and an electronic camera 1 can perform rotation of zooming and a polarizing plate 3 by the motor style 5. The light source 6 of a spotlight etc. is attached in the upper part of an electronic camera 1, and the front face of the light source 6 is equipped with a polarizing plate 7 and the quarter-wave length plate 8. The motorised electric pan head 9 is equipped with an electronic camera 1, and a neck swing is horizontally free for it in a perpendicular list. The

electric pan head 9 builds in a control unit 10, and controls pan actuation by the instruction from the computer 11 mentioned later.

[0008] The RGB code which an electronic camera 1 outputs is changed into a digital signal by A/D converter 13 of the video camera input device 12, and is written in a frame memory 14 as image information. data processing of the written in image information is carried out by computer 11, and a hue coordinate asks for it while reappearing on a monitor's CRT 15 screen -- having -- the result of an operation -- CRT16 -- graphical display -- or a digital readout can be carried out. The directions to a computer 11 are inputted into key boat 17 list with a mouse 18, perform all of rotation of zooming and a polarizing plate 3, ON/OFF of the light source 6, etc. in the position control of the electric pan head 9, and ON / off list of an electronic camera 1 from a computer 11, and input a control signal into an electronic camera 1 and each control unit 1a and 10 of the electric pan head 9 with cables 19 and 20 through a RS-232C interface (not shown).

[0009] 21 and 21 -- is the photoelasticity gage stuck on the front face of the structures, such as a tunnel lining object. The photoelasticity gage 21 and 21 -- are usually 5-6mm in width of face of 1cm, die length of 5cm, and thickness; and stick the both ends of the die-length direction on the structure (not shown) with adhesives. Next, the measurement procedure of the amount of stress strains of the structure is explained with reference to the flow chart of drawing 2. First, as a preceding paragraph story of measurement, the photoelasticity gage 21 is beforehand stuck on the same ingredient as the object structure, a polarizing plate is passed and the light from the light source is projected on the photoelasticity gage 21. And the reflected light of the photoelasticity gage 21 is caught with an electronic camera 1, and it displays on a monitor CRT 15. When it is stuck on point of measurement, while not presenting purple, it outputs a control signal to control device 1a of an electronic camera 1, rotates a polarizing plate 3, and it is made for the photoelasticity gage 21 on a screen to appear purple by actuation of a keyboard 17, although the photoelasticity gage 21 presents purple in the condition that stress is not acting. A computer 11 is made to memorize by making the rotation location of the polarizing plate 3 at this time into a criteria include angle. If fixed stress is added to an object and a strain is generated after that, the color of the photoelasticity gage 21 on a screen will change. The hue vector coordinate and the amount of stress strains of a RGB input signal of the photoelasticity gage 21 at this time are memorized, several steps stress is changed, and data are collected. [of image area] And by the operation of a computer 11, the conversion table of the amount of strains and a hue coordinate is generated in a stress list, and this is stored in the store of a computer 11 as a correspondence table (101).

[0010] Moreover, photoelasticity gages 21 and 21 which install an electronic camera 1 in a measurement location, operate the motor style 5 of the electric pan head 9 and an electronic camera 1 with a keyboard 17 or a mouse 15, and are shown in drawing 1 -- The thing of inner arbitration is copied out on a monitor's CRT 15 screen with a predetermined dilation ratio. When the color of the photoelasticity gage 21 copied out on the screen is not purple, a polarizing plate 3 is rotated and it is made in agreement with a purple hue coordinate. And each controlled variable of the electric pan head 9 at this time, the motor style 5, and a polarizing plate 3 is stored in a computer 11. This activity is done to all the photoelasticity gages 21 and 21 -- (102).

[0011] And they are each photoelasticity gages 21 and 21 to a computer 11. -- Measurement sequence and the program of measurement time of day are inputted (103). If activation of processing is made to start after that, a computer 11 will start an electronic camera 1 and the light source 6 at predetermined time of day, and will control the electric pan head 9. And the optical axis of an electronic camera 1 is made in agreement with the photoelasticity gage 21 specified by the program, predetermined zoom actuation is performed, and a frame memory 14 is made to memorize the photoed picture signal. And the hue coordinate of the predetermined image area in the memorized picture signal is calculated, and it writes in a store by making this into measurement data, making the amount of strains and stress corresponding to a hue coordinate as read-out from the correspondence table currently written in the store (104).

[0012] According to a measurement program, sequential execution of the activity mentioned above is carried out till termination, and the data of the hue coordinate of each point of measurement, a strain, and stress are stored. The data memorized by the computer after measurement termination or during measurement can be displayed on CRT16, or can be picked out from printer equipment as hard copy (105). Moreover,

online transmission of the data can be carried out to a remote computer lab, and the data of many sites can also be intensively processed and managed to it (106).

[0013] Moreover, as the approach of stress computation, the approach described below may be used. First, the correspondence table of the rotation of a polarizing plate 3 and change of a hue coordinate is set as the computer 11. And the hue coordinate of the inputted RGB code is searched for, and the rotation N of the polarizing plate from the purple hue coordinate which is criteria is calculated on a correspondence table. Strain epsilon and stress sigma are calculated by the degree type from a rotation N.

[0014]

[Equation 1]

Thus, while being able to collect a lot of measurement data automatically and being able to perform data processing and management, it can measure to arbitration at any time by keyboard grabbing. In addition, neither the configuration of measuring equipment nor the calculation approach of stress is limited to this example, but various modification is possible for it, and, naturally this invention attains to those changed things.

[0015]

[Effect of the Invention] Since this invention measures a strain optically in the stress list of the structure as explained in full detail in the one above-mentioned example, between the object structure and metering devices is wireless-ized, wiring becomes unnecessary, and materials and efforts are reduced. Moreover, since measurement is performed automatically, the stress measurement activity of a hazard area can be fully automated, and fear of accident can be canceled. Furthermore, it is mitigated remarkably, and the effort of a measurement activity covering a long time can process a lot of data, and demonstrates remarkable effectiveness to laborsaving.

TECHNICAL FIELD

[Industrial Application] This invention relates to the stress measuring method which measures the stress strain of the structure optically about a stress measuring method.

PRIOR ART

[Description of the Prior Art] Conventionally, the strain gage is used for measurement of a stress strain of the structure. This approach sticks a strain gage on the front face of the structure to measure, measures change of the electric resistance between the both-ends children of a strain gage, and converts it into the amount of strains.

EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the stress measuring method by the strain gage mentioned above connects a measuring instrument and a strain gage with an electric wire, when a large number [point of measurement], the quantity of an electric wire also increases, and wiring and management become complicated. Then, wiring is made unnecessary, the technical technical problem which should be solved in order to collect data automatically and to attain reduction and laborsaving of materials arises, and this invention aims at solving this technical problem

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MEANS

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OPERATION

[Function] If the light which passed the polarizing plate to the photoelasticity gage is irradiated and the reflected light is observed with an electronic camera through a polarizing plate, the hue of a photoelasticity gage will change with the amounts of strains of a photoelasticity gage. Also with angle of rotation of a polarizing plate, a hue changes and can measure the amount of strains of a photoelasticity gage by getting to know the variation rate of polarization angle of rotation. The hue of the output signal of an electronic camera also changes with hue change of a photoelasticity gage, a processing unit calculates the amount of strains with an operation means to compute the amount of strains of a photoelasticity gage from the hue coordinate of an RGB code, and the stress of the part on which the photoelasticity gage was stuck is measured from the calculated amount of strains.

[0006] In addition to the operation which mentioned above invention according to claim 2, actuation of photography equipment and arithmetic units, such as an electronic camera and the light source, is controlled by the control unit, and measurement and data processing are automatically performed according to the set-up program.

EXAMPLE

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of stress measuring equipment.

[Drawing 2] The flow chart which shows the process of stress measurement.

[Description of Notations]

1 Electronic Camera

3 Seven Polarizing plate

4 Eight Quarter-wave length plate

6 Light Source

11 Computer

14 Frame Memory

21 Photoelasticity Gage